Evaluating the inevitability of a phonological change: /æ/ in Philadelphia

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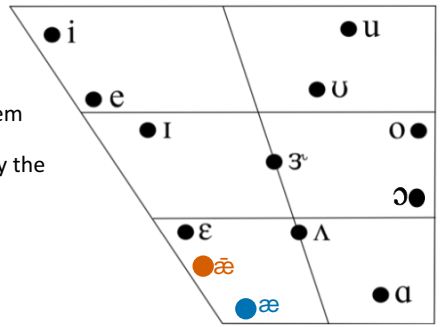
What is happening to /æ/ in Philadelphia?

2 allophones of /æ/:
- "Tense": [iə ~ ɛː]
- "Lax": [æ]

The complex Philadelphia System (*Philly*) of distributing these allphones is being replaced by the simpler Nasal System (*Nasal*)



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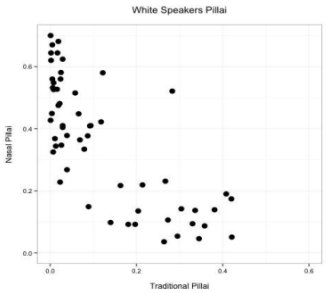

Questions:

Overarching question:
- Is it inevitable that a system as complex as *Philly* would be replaced by *Nasal?*

Specific questions:
- What is the likelihood that given *Philly* input data, learners would hypothesize a *Nasal* grammar?
- Once both *Philly* and *Nasal* grammars are available, is *Nasal* destined to win in grammar competition?

Outline

- A brief overview of the *Philly* and *Nasal* systems.
- A productivity analysis to see whether a *Nasal* grammar is plausible given *Philly* input.
- A grammar competition analysis to see whether *Nasal* is destined to replace *Philly*.
  - A brief diversion into challenges we faced when trying to apply grammar competition models to phonology.

The Philadelphia and Nasal Systems

The Philadelphia System

Lexical Exceptions:

if æ ∈ L_{tense} *then* æ̃

if æ ∈ L_{lax} *then* æ

Phonological Regularity

if æx *and* $x]_{\sigma}]_{\text{stem}}$ *and* $x \in P$ *such that*

$P = (\text{nasals} \cup \text{voiceless fricatives}) \cap \text{anterior}$

then æ̃

else æ

The Philadelphia System

Anteriority:

	← tense	lax →	
ham	ban		bang
calf path	pass	cash	

Syllabicity:

← tense	lax →
ham	hammer
cast	castle

The Philadelphia System: Abstractness

Affixation

	← tense	lax →
class	classes	classic
man	manning	Manning
classing		

Truncation

← tense	lax →
mathematics	math
examination	exam

The Philadelphia System: Abstractness

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The Philadelphia System: Abstractness

Syncope

← tense	lax →
family: [fæ.mə.li] & [fæm.li]	camera: [kæ.mə.rə] & [kæm.rə]

Assimilation

← tense	lax →
fan club: [fæn.klʌb] [fæŋ.klʌb]	fang club: [fæŋ.klʌb]

The Philadelphia System: Lexical Exceptions

L_{lax} {(ran, swam, began, and, can, than), aspirin, carafe, alas}

L_{tense} {mad, bad, glad}

The Philadelphia System

Basic segmental conditioning
+ Complicated morphological interactions
+ Lexical exceptions

Tensing of /æ/ before anterior, tautosyllabic [nasals, voiceless fricatives]

Applies at stem level

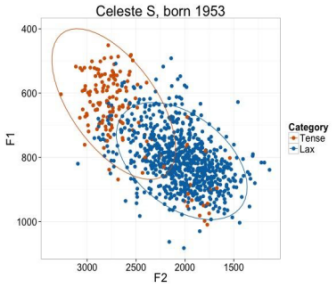
Inflectional vs. **derivational** morphemes

Learned words

Class 3 strong verbs (past tense)

Mad, bad, glad

ask	aspirin	caraffe
ran	swam	began
mad	bad	glad



Productivity Analysis

The similarity between *Philly* and *Nasal*

Philly: Tensing of /æ/ before anterior, tautosyllabic [nasals, voiceless fricatives]

Nasal: Tensing of /æ/ before [nasals]

Condition	Example	Philly	Nasal
Ant. tautosyll. Voiceless Fric	pass	tense	lax
MBG exceptions	mad, bad, glad	tense	lax
Anterior tautosyll. nasals	man, ham	tense	tense
Anterior heterosyll. nasals	hammer, manage	lax	tense
Posterior nasals	hang, bank	lax	tense
Nasal exceptions	ran, and	lax	tense
Elsewhere	cat	lax	lax

Yang's Productivity Model

$T \leq N / \ln(N)$

Tolerance Principle: A productive rule can handle N/ln(N) exceptions

Is the *Nasal* system a plausible rule, given *Philly* input?

Token (*Philly*)	Expectation (*Nasal*)	Exception?
mæ̃n	mæ̃n	no
cæt	cæt	no
bæ̃d	bæd	yes

T = total number of exceptions

N = total number of /æ/ words

Applying Tolerance Principle

CHILDES database (MacWhinney, 2000)

Applying Tolerance Principle: most frequent words

Productivity Wrap Up

Grammar Competition

Philly and *Nasal* in competition

Yang's Grammar Competition Model

Fitness (G) = proportion of unambiguously 'G' clauses it generates out of all the clauses it generates.
If Fitness(G1) > Fitness(G2), G1 wins.
V2 and SVO competing

Ambiguous	SVO
V2 Advantage	XVSO, OVS
SVO Advantage	SXVO, XSVO

The Challenge in Applying Competition to Phonology

Philly and *Nasal* competing

	strings	Fitness(G) = proportion unambiguous
Ambiguous	h[æ]m, c[æ]t	0.8
Nasal Advantage	h[æ]mmer, h[æ]ng, c[æ]st, b[æ]d	0.2
Philly Advantage	h[æ]mmer, h[æ]ng, c[æ]st, b[æ]d	0.2

The Challenge in Applying Competition to Phonology

Fitness(G) = tense where other has lax

Ambiguous	h[æ]m, c[æ]t	
Nasal	h[æ]mmer, h[æ]ng	
Philly	c[æ]st, b[æ]d	

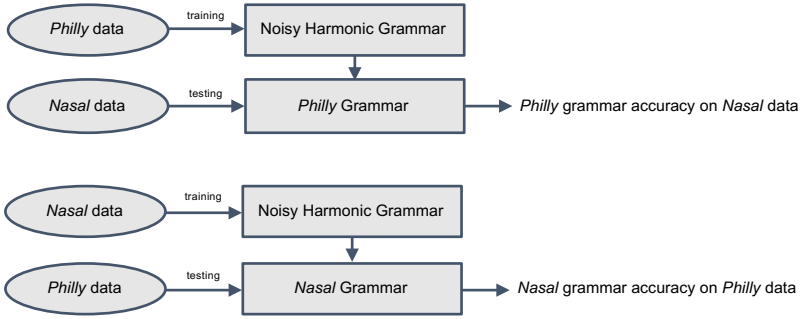
Fitness(G) = lax where other has tense

Ambiguous	h[æ]m, c[æ]t	
Nasal	c[æ]st, b[æ]d	
Philly	h[æ]mmer, h[æ]ng	

van der Feest & Fikkert (2015) found children detected default-for-marked errors, but not marked-for-default.

Sneller (2015): Philadelphian listeners downgrade both c[æ]t and h[æ]m.

Noisy Harmonic Grammars



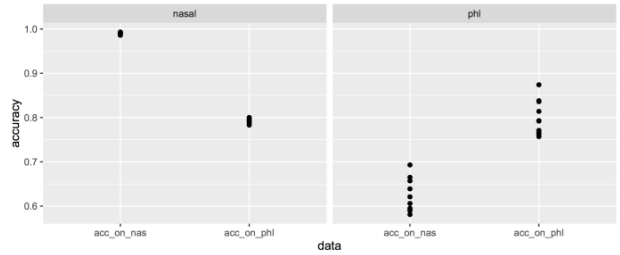
Noisy Harmonic Grammars

Constraint Set =

*æ *æ̃
*æ]σ *æ̃]σ
*æm, *æn, *æs, *æp, … *æ̃m, *æ̃n, *æ̃s, *æ̃p, …
*æ]σm, *æ]σn, *æ]σs, *æ]σp, … *æ̃]σm, *æ̃]σn, *æ̃]σs, *æ̃]σp, …

10 chains, 9,000 training iterations

Harmonic Grammar Results



Conclusions

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